

ABSTRACTS<sup>1</sup> FROM THE 2004 ANNUAL MEETINGS OF THE  
SOCIETY FOR NORTHWESTERN VERTEBRATE BIOLOGY, THE  
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FIELD PEDAGOGY FOR EXAMINING LOCAL-SCALE TEMPERATURE VARIATION  
IN VALLEY ENVIRONMENTS. J ANTHONY ABBOTT, MARC FAIRBANKS, *Department of  
Geography and Land Studies, Central Washington University, Ellensburg, WA.*

PARTNERING FOR AMPHIBIAN AND REPTILE CONSERVATION: THE  
INTEGRATION OF PNARC AND PARC. THOMAS SB AKRE, *Savannah River Ecology  
Laboratory, Aiken, SC.*

MOUNTAIN CARIBOU SURVIVAL IN THE SOUTHERN SELKIRK MOUNTAINS. JON  
A ALMACK, *Washington Department of Fish and Wildlife, Metaline Falls, WA*; ROBERT B  
WIELGUS, *Washington State University, Pullman, WA.*

Endangered mountain caribou (*Rangifer tarandus caribou*, mountain ecotype) were monitored from 1996 to 2003 as part of an international, interagency recovery program in the Selkirk Mountains of northeastern Washington, northern Idaho, and southern British Columbia. The major objectives of the project were to augment the resident population of approximately 30 animals with 3 caribou transplants and to closely monitor caribou mortality, allowing for calculation of annual survival rates for the population. Forty-three caribou were transplanted from central British Columbia: 19 in 1996, 13 in 1997, and 11 in 1998. Nine resident caribou were also radio-marked as a control group. Each of the collared caribou was monitored by aerial radio telemetry either to fate or to the end of the field project in July 2003. We investigated mortalities to determine cause of death and to calculate annual survival rates for all marked caribou by transplant or resident status, by transplant group, by sex, and by season. Overall caribou survival rates did not significantly differ by transplant or resident status, or by sex, although survival differed by transplant group and by season of mortality. Mortality the year of capture was high, whether the caribou were transplanted or were residents released on site. However, all transplant groups and residents showed significantly higher survival rates in years following capture. Persistence of this endangered population will likely depend on continued augmentation by transplants from wild populations or from a captive herd and on changes in habitat management strategies in British Columbia.

FINDING FAULT OR FIXING THE FUTURE?: A CASE STUDY OF FISH HABITAT IN  
THE ENTIAT RIVER WATERSHED. PHILIP ARCHIBALD, *USDA Forest Service, Okanogan-  
Wenatchee National Forests, Entiat, WA.*

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<sup>1</sup> Abstracts are only included for papers whose content would normally be published in *Northwestern Naturalist*. Only titles, authors, and addresses are presented for non-vertebrate papers.

WASHINGTON'S NATURAL AREAS CONTAIN GUIDES TO EARTHQUAKE HAZARDS. BRIAN F ATWATER, *USGS and Department of Earth and Space Sciences, University of Washington, Seattle, WA.*

EFFECTS OF REMNANT PATCH SIZE ON THE RICHNESS AND ABUNDANCE OF BRYOPHYTE FUNCTIONAL GROUPS IN TEMPERATE RAINFORESTS OF COASTAL BRITISH COLUMBIA, CANADA. LK BALDWIN, GE BRADFIELD, *Department of Botany, University of British Columbia, Vancouver, BC.*

ARROYOS IN THE FOSTER CREEK WATERSHED, WASHINGTON STATE. PAUL BLANTON, *Resource Management, Central Washington University, Ellensburg, WA.*

DEVELOPING PATIENT AND TEMPLATE ANALOGS FOR SELECT GEOMORPHIC AND HABITAT CORRELATES FOR THE YAKIMA RIVER ECOSYSTEM DIAGNOSIS AND TREATMENT (EDT) MODEL. PAUL BLANTON, *Resource Management, Central Washington University, Ellensburg, WA*; ANTHONY GABRIEL, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA*; LUKE SWAN, *Resource Management, Central Washington University, Ellensburg, WA*; MORRIS L UEBELACKER, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA.*

INSHORE MARINE BIRD ABUNDANCE CHANGES IN THE SOUTHERN STRAIT OF GEORGIA: AN INTEGRATED RESEARCH AND EDUCATION PROGRAM. JOHN BOWER, SANDLIN PREECES, HOLLY DONOVAN, LYDIA MILLER, MARC AUTEN, BRIAN CARY, CAANAN COWLES, RAINY DIEHL, CASSIDY GRATTAN, JOHANNA HOBART-CRANE, HANNAH PADEN, ADAM PECK-RICHARDSON, BECKY ROWLAND, SUZANNE SANBORN, MARCI STAUB, *Fairhaven College, Western Washington University, Bellingham, WA.*

The 1978 to 1979 Marine Ecosystems Analysis Puget Sound Project (MESA) provided baseline data for marine bird abundance of southern Strait of Georgia and adjacent waters. Since that time, census work has been limited to the Puget Sound Ambient Monitoring Program's (PSAMP) biannual aerial surveys, summer marbled murrelet counts, breeding island censuses, and Christmas Bird Counts. While the PSAMP study has suggested dramatic declines in abundance for a number of species, geographic, methodological and/or temporal considerations limit conclusions. Therefore we have undertaken a study to test for changes in marine bird abundance in the southern Strait of Georgia by repeating significant portions of the MESA study. A 2nd objective is to integrate science research and educational opportunities for undergraduate and graduate students. In our research we have conducted bi-weekly point counts from approximately 100 land-based sites and have conducted transect surveys from aboard 3 ferry routes. Our 1st year results suggest declines of surf scoter (*Melanitta perspicillata*), western grebe (*Aechmophorus occidentalis*), brant (*Branta bernicla*), scaup (*Athya* spp.), and red-necked grebe (*Podiceps grisegena*) abundance. Abundance increases were noted for Caspian tern (*Sterna caspia*), pigeon guillemot (*Cepphus columba*), common loon (*Gavia immer*), and double-crested cormorant (*Phalacrocorax auritus*). Our 1st year results largely agree with the PSAMP study, with some exceptions, and provide comprehensive data to compare with future marine bird census studies.

CHANGES IN FOREST RODENT COMMUNITIES AFTER FIRE: IMPLICATIONS FOR DISPERSAL AND REGENERATION OF PINE. JENNIFER S BRIGGS, *Biological Resources Research Center, University of Nevada-Reno, Reno, NV*; STEPHEN B VANDER WALL, *Evolution and Conservation Biology, University of Nevada-Reno, Reno, NV.*

We investigated the effects of prescribed and wild fire in the eastern Sierra Nevada on: 1) the size and diversity of small-mammal communities, 2) the rates at which animals foraged for and cached Jeffrey pine

(*Pinus jeffreyi*) seeds, and 3) the survival and establishment of seeds planted both before and after fires. Annual trapping sessions on 7 prescribed burn plots at Incline Village, Lake Tahoe, NV, showed that small mammal populations declined for 2 y after burns. Species composition [primarily chipmunks (*Tamias* spp.), deer mice (*Peromyscus maniculatus*) and golden-mantled ground squirrels (*Spermophilus lateralis*)] remained relatively constant as numbers increased to pre-burn levels over 3 y. More animals trapped on burned plots were new captures; more former residents were captured on control plots. Foraging rates reflected population size. Seed caching occurred on freshly burned plots but was difficult to quantify due to drought. However, seeds that we planted in artificial caches (to mimic animal dispersal) both before and after fires survived significantly better than seeds placed on the forest floor (typical of wind dispersal). On a nearby wildfire site, rodent populations declined for 2.5 y, and deer mice dominated the post-fire community. Although no natural caching was observed on this burn for 4 y, emergence and survival of seedlings from artificial caches was significantly greater than in adjacent unburned forest. Our results suggest that seed-caching animals may remain in or re-colonize burned areas shortly after both prescribed and wild fires, and may play an important role in facilitating pine regeneration.

SEASONAL DEMOGRAPHY AS A CONSEQUENCE OF METABOLISM, BEHAVIOR, AND COLOR MORPHOLOGY IN *PSEUDACRIS REGILLA*. ARTHUR BUCHAN, LIXING SUN, R STEVEN WAGNER, *Department of Biology, Central Washington University, Ellensburg WA.*

Population dynamics, microhabitat occupation, and metabolic rates were measured in the Pacific treefrog (*Pseudacris regilla*) to determine the interaction between environmental and behavioral factors that could account for color differences. Color morphology (green or non-green) and microhabitat features (temperature, relative humidity, and light exposure) were measured at the point of capture on 468 frogs. Fifty-nine individuals were recaptured, which allowed for growth measurements and population estimations (Jolly-Seber; Heyer and others 1994).  $VO_2$  consumption was measured on 84 individuals at 25.13°C and 35.13°C to determine the influence of temperature on *P. regilla* metabolic rates. The results suggest environmental conditions may pressure recently metamorphosed juveniles to exhibit a green color morphology, making them cryptic to summer foliage. In contrast, adults displayed a non-green color morphology that was cryptic to spring foliage and understory habitat. Subsequently, juveniles preferred a warm, dry, and open microenvironment, while sexually mature adults preferred a cool, humid, and less open microenvironment. Additionally, the population dynamics study shows that juveniles that do not reach sexual maturity by the following spring are at a significant risk of predation. In conclusion, cryptic coloration, energy consumption, and predation risk between classifications may contribute to different color morphologies seen in *P. regilla*.

MOVEMENTS OF WESTERN TOADS IN BURNED AND UNBURNED FORESTS IN NORTHEASTERN OREGON. EVELYN L BULL, BARBARA C WALES, *USDA Forest Service Pacific Northwest Research Station, LaGrande, OR.*

Western toads (*Bufo boreas*) are 1 of many species of amphibians that have declined in some portions of their ranges. The objective of this study was to gather information on toad movements and the effects of disturbance events, like wildfire, which may provide some explanation for population declines of this species. Movements of 19 radio-tagged western toads were monitored from June through October 2002 in northeastern Oregon. A variety of GIS analyses were used to evaluate and illustrate toad movements in relation to fire, topography, and habitat. After breeding in June, some toads moved extraordinary distances (up to 3.6 km) to the summering and overwintering habitat. Female western toads (mean = 2112 m) traveled longer distances than males (mean = 961 m). Movements were predominantly linear with considerable elevation change (for example, 530 m) and without a preference for direction. Toads went to sites that contained a source of water and cover (burrows or rocks), maximized solar radiation, and provided a source of prey (predominantly ants and beetles).

FIRE AND HAZARDOUS FUEL REDUCTION IN THE WEST: PERSPECTIVES AND CHALLENGES. R BRUCE BURY, *USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR*; DAVID PILLIOD, *USDA Forest Service, Rocky Mountain Research Station, Missoula, MT*; EVELYN L BULL, *USDA Forest Service, Pacific Northwest Research Station, LaGrande, OR*.

HERBICIDE EFFECTS ON METAMORPHOSIS OF AMPHIBIAN LARVAE (*RANA CASCADAE*). KATHERINE CAUBLE, R STEVEN WAGNER, *Department of Biological Sciences, Central Washington University, Ellensburg, WA*.

The interaction of pesticides and herbicides with aquatic species is of increasing concern in northwest ecosystems. To address this issue we investigated the effects of a commercially available herbicide (glyphosate) on amphibian development. The herbicide glyphosate is used widely because it is suggested to have a low environmental persistence time. However, its application during the period of amphibian metamorphosis could increase their risk of mortality. Therefore, we examined the effects of 3 different glyphosate treatments (0 ppm, 1 ppm, and 2 ppm) on *Rana cascadae* larval development in static tests with replacement over the course of 45 d until all animals either died or metamorphosed. Treatment levels included 5 replicates with 7 larvae for each. Results indicated a significant difference in time to death (TTD) among treatments (ANOVA,  $F = 119.31$ ,  $P < 0.00$ ), with no evidence for a difference among treatments. Mean time to death for each treatment was 42, 33, and 8 d for 0 ppm, 1 ppm, 2 ppm, respectively. Further, surviving animals at the highest concentration of glyphosate (2 ppm) had delayed eruption of forelimbs and backlimbs and lower dry mass at metamorphosis compared to the other treatments. In sum, the herbicide glyphosate does affect *R. cascadae* larval mortality and metamorphosis in static laboratory experiments.

PROJECT CROAK: POPULATION DYNAMICS OF AMPHIBIANS IN ZILLAH, WASHINGTON. JEFF CHARBONNEAU, KEN JOHNSON, TRACI ANDERSON, *Zillah High School, Zillah, WA*; ARTHUR BUCHAN, TIM ENGLUND, GRAEME AGGETT, R STEVEN WAGNER, *Central Washington University, Ellensburg, WA*.

HOW PRE-DISPERSAL INSECT HERBIVORES AFFECT VIABLE SEED PRODUCTION OF *ASTRAGALUS SINUATUS*, A WASHINGTON STATE ENDANGERED PLANT SPECIES. JULIE K COMBS, *College of Forest Resources, University of Washington, Seattle, WA*.

MAMMAL RESPONSES TO THE 1980 ERUPTIONS OF MOUNT ST. HELENS. CHARLES M CRISAFULLI, *USDA Forest Service, Pacific Northwest Research Station, Olympia, WA*; JAMES A MACMAHON, *Department of Biology, Utah State University, Logan, UT*; ROBERT R PARMENTER, *Valles Caldera National Preserve, Los Alamos, NM*.

The 1980 eruptions of Mount St. Helens created a complex mosaic of disturbance effects over a 600-km<sup>2</sup> area. The resulting landscape included several broadly defined disturbance zones distinguished by the mechanism of volcanic disturbance, and the type, condition, and quantity of residual forest elements that remained following the eruptions. From 1980 to 2003 we live-trapped small mammals [Rodentia, Insectivora, Lagomorpha, and Carnivora (Mustelidae)] at 40 sites within the tephra-fall, blowdown, tree removal, and pyroclastic flow zones to assess patterns of mammal survival and colonization. Survival was inversely related to disturbance intensity within the 4 disturbance zones studied: tephra-fall zone (11 species), blowdown zone (8 species), tree-removal zone (2 species), and pyroclastic flow zone (0 species). Timing of the eruption and species' life history traits were important factors influencing mammal survival. The primary mammal colonists were generalist species associated with early successional habitats (for example, *Peromyscus maniculatus*), forest insectivores (for example, *Sorex trowbridgii*), and riparian habitat specialists (for example, *Sorex palustris*). Diverse mammal assemblages formed in small, isolated, and structurally complex habitat patches that developed in areas of high moisture, embedded in large expanses of barren landscape. The rate of col-

onization was surprisingly rapid, and within 10 to 12 y of the eruption the majority of mammal species found in the southern Washington Cascade Range had colonized even the most severely disturbed zones, indicating that the size of the Mount St. Helens disturbance was not a barrier to colonization. Habitat structure, including both residuals (logs, vegetation, and soil) and developing vegetation, appeared to be the factor most important in governing mammal reassembly at Mount St. Helens during the first 2 decades following the 1980 eruptions.

ASSESSING GENE FLOW BETWEEN THE CLOSELY RELATED SPECIES, DEL NORTE SALAMANDER (*PLETHODON ELONGATUS*) AND SISKIYOU MOUNTAINS SALAMANDER (*PLETHODON STORMI*), UTILIZING 11 NOVEL MICROSATELLITE MARKERS. DOUGLAS J DEGROSS, *Department of Zoology, Oregon State University, Corvallis, OR*; LOUISE S MEAD, *Section of Evolution & Ecology, University of California, Davis, CA*; STEVAN J ARNOLD, *Department of Zoology, Oregon State University, Corvallis, OR*.

We developed 11 novel microsatellite markers to assess gene flow between Del Norte salamander (*Plethodon elongatus*) and Siskiyou Mountains salamander (*P. stormi*) in Siskiyou County, California. The 11 markers were highly variable (7–37 alleles). Both species showed fixed differences (61 unique alleles in *P. elongatus*; 45 unique alleles in *P. stormi*). A Bayesian clustering program was used to assign individuals to population clusters based upon their allelic identities. The southern *P. stormi* populations are more closely related to their northern counterparts in the Applegate River Valley than to *P. elongatus*. There are localities within 5 km of the border between the 2 species that are demonstrating evidence of gene flow. These results may have implications for the management of *P. stormi*, which is a threatened species in the state of California.

ADAPTATION TO TEMPERATURE STRESS IN TORRENT SALAMANDERS: EXPRESSION OF HEAT SHOCK PROTEINS (HSP70). LYN DEHEN, R STEVEN WAGNER, *Department of Biological Sciences, Central Washington University, Ellensburg WA*.

Heat shock proteins (Hsps) are produced by almost all organisms to aid in the refolding or removal of proteins due to stress-induced damage caused by pollutants, excessive siltation, and increased temperatures. Torrent salamanders (*Rhyacotriton cascadae* and *R. variegatus*), which are endemic to the northwest, have the narrowest temperature tolerances recorded for any amphibian. They are found in cold, clear, fast moving streams in association with mature forests where stream temperatures do not usually exceed 13°C. Therefore, torrent salamanders may not be adapted to protect themselves from increases in stream temperatures due to loss of riparian vegetation or forest canopy. The objective of this study is to determine if these species produce hsp70 in measurable quantities when exposed to increased temperatures. The Critical Thermal Maximum (CTM) was determined for each animal followed by a 2-wk acclimation period after which each individual was heat shocked at 5° below their CTM. HSP/HSC70 content was determined by SDS-PAGE and Western blotting using a monoclonal antibody specific for the HSP/HSC70 protein. Results indicated no significant difference in CTM among species, larvae or adults (average CTM 27.6°C;  $n = 58$ ). In addition, measurable amounts of both constitutively expressed and induced Hsp70 were found in heat-shocked samples; however, only constitutively expressed Hsc70 was found in control samples. In summary, the presence of limited amounts of inducible Hsp70 suggests torrent salamanders can respond to thermal stress; however, it might not be adequate for large temperature fluctuations or in interactions with other stressors.

DETECTING ALIEN INVADERS FROM SPACE: TOOLS TO IDENTIFY CHEATGRASS INVASION IN THE SHRUB STEPPE USING SATELLITE REMOTE SENSING IMAGERY AND GIS. JANELLE DOWNS, JERRY TAGESTAD, GREGG PETRIE, *Pacific Northwest National Laboratory, Richland, WA*.



REPRODUCTIVE ECOLOGY OF SAGE THRASHER (*OREOSOPTES MONTANUS*) IN A DISTURBED LANDSCAPE. SCOTT DOWNES, *Central Washington University, Ellensburg, WA*.

The sage thrasher (*Oreoscoptes montanus*) is a species characteristic of native shrub-steppe zones in the Columbia Basin. Much of the basin is currently under the influence of human-induced disturbance or has the potential to be affected by disturbance. One result of such disturbance is an invasion by exotic weeds such as cheatgrass (*Bromus tectorum*). Sage thrashers are known to prefer bare ground for foraging and prefer tall, dense big sagebrush (*Artemisia tridentata*) for nesting and territory establishment. Previous studies have found that, in areas of high disturbance, the amount of bare ground is negatively correlated with height of *A. tridentata*. The reproductive ecology of sage thrashers was examined, in both areas of native shrub-steppe and areas disturbed by grazing or containing invasive weeds. The goals of the project were to find: 1) what habitat variables drive territory size and pairing, and 2) how nests and development of young are related to territory vegetation characteristics. Territories were mapped and then monitored for pairing and nests. Vegetation was measured using Daubenmire quadrats placed on transects within each territory. As in previous studies, I found shrub height was greater in areas of disturbance. Sage thrasher territory size was negatively correlated to shrub height. Territory size did not increase in response to disturbance. Birds paired less frequently in areas of reduced bareground and in areas of increased cover of *B. tectorum*. There was a high failure rate of nests (54%), yet this did not differ between habitat conditions. Nestling growth or condition did not differ between habitat conditions.

ADULT PACIFIC LAMPREY MIGRATORY BEHAVIOR AT PRIEST RAPIDS PROJECT USING RADIO-TELEMETRY, MID COLUMBIA RIVER, WASHINGTON, USA. THOMAS J DRESSER JR, *Public Utility District No. 2 of Grant County, Ephrata, WA*; BRYAN NASS, *LGL Unlimited, Sidney, BC*; LOUISE M PORTO, *Golder Associates, Castlegar, BC*.

The Pacific lamprey, a jawless anadromous fish, is indigenous to the Columbia River and is reported to be an important fish of cultural, utilitarian, and ecological significance (Close and others 2002). Pacific lamprey populations of the Columbia River have significantly declined in abundance in recent years as evidenced by counts at dams on the lower Columbia and Snake rivers (Close and others 1995; Vella and others 1999; Close and others 2002). Specific reasons for this decline are not fully understood, but have been related to similar factors contributing to the decline of Pacific salmon. The life history of Pacific lamprey is similar to salmon, in that spawning migrations are necessary to complete their life cycle. Adult lamprey migration past dams and through reservoirs has been investigated in the lower Columbia River; however, information for the mid-Columbia River is limited. Pacific lamprey were captured and radio-tagged from July to September (2001 to 2002) at Priest Rapids Dam on the mid-Columbia River. In total, 125 lamprey were implanted with radio-tags and their movements were monitored to determine passage timing and passage success at both Priest Rapids and Wanapum hydroelectric projects.

GENETIC ANALYSIS OF REDBAND/RAINBOW TROUT FROM TRIBUTARIES WITHIN THE PRIEST RAPIDS PROJECT AREA, MID-COLUMBIA RIVER, WASHINGTON, USA. THOMAS J DRESSER JR, *Public Utility District No. 2 of Grant County, Ephrata, WA*; MADISON POWELL, JOYCE FALER, MATTHEW CAMPBELL, *Center for Salmonid and Freshwater Species, Risk University of Idaho, Hagerman, ID*.

Rainbow trout (*Oncorhynchus mykiss*) have been stocked more widely in North America than any other member of the genus *Oncorhynchus* (Behnke 1992). These stocking events have often led to hybridization and introgression with native redband and rainbow trout and in some instances have led to the complete replacement of native trout populations by non-indigenous hatchery rainbow trout. Concern about the loss of genetic integrity of native trout populations has prompted several studies designed to identify genetically pure native populations. Intraspecific hybridizations and intra-species replacement events are often difficult to detect using phenotypic characters (Williams and Jaworski 1995). Therefore, various molecular genetic techniques have been developed to allow for a more informative assessment of population structure and systematics than morphological based analyses (Williams and Jaworski 1995). Information concerning the

genetic diversity, variation, and genetic population structure of redband/rainbow trout was investigated using mitochondrial and nuclear restriction fragment length polymorphism (RFLP) markers. Tissue samples from 7 separate sample populations of redband/rainbow trout were compared to hatchery rainbow trout and steelhead (wild and hatchery) tissue samples collected from Wells Hatchery. Data examined suggest 4 aggregates of samples: 1) a hatchery rainbow trout population, 2) a single distinct stream population (Johnson Creek), and 3) 2 steelhead sample populations (wild and hatchery origin) that are not significantly different from each other, but together are different from the stream population and the hatchery rainbow trout population. Genetic distance estimates suggest the hatchery rainbow trout population is an admixture from several maternal lineages.

RESEARCH SUMMARY AND THREATS ASSESSMENT FOR NORTHERN WORMWOOD (*ARTEMISIA CAMPESTRIS* VAR. *WORMSKIOLDII*) IN THE PRIEST RAPIDS HYDROELECTRIC PROJECT AREA. THOMAS J DRESSER JR, *Public Utility District No. 2 of Grant County, Ephrata, WA.*

MONITORING PLANT POPULATIONS: WHAT TO MEASURE AND HOW TO MEASURE IT? PETER W DUNWIDDIE, *The Nature Conservancy, Seattle, WA.*

RIVER CONTINUUM CONCEPT AND MANAGEMENT EFFORTS—THE CASE OF THE TAILED FROG. LINDA A DUPUIS, PIERRE FRIELE, *Ascaphus Consulting, Squamish, BC.*

Tailed frogs are specialized animals that rely on old-growth forests and clean, cool creeks for survival. Studies have documented short- and long-term declines in adults and tadpoles associated with timber harvesting activities, which are prevalent in the landscape. Given that upstream disturbances can have downstream consequences, we investigated the interaction between tailed frogs and the fluvial environment as a whole. Surveys were carried out through whole basins, from confluence to headwaters, and distribution patterns were explored in relation to regional- and watershed-level parameters, as well as site-level characteristics. Results suggest that distribution and abundance are governed primarily by basin size, ruggedness, aspect, and precipitation regime. These watershed-level controls are strongly influenced by the climate and geology of a region. Discharge rates, disturbance regimes, stream temperatures, reach slope, substrate type, and embeddedness affect *Ascaphus*, but these habitat variables are also driven by higher level controls. An ideal stream drains a small (3 to 10 km<sup>2</sup>), moderate to moderately steep (30 to 90%) basin, with moderate rainfall, stream temperature, and disturbance regimes. For example, in the steep windward mountains of the north coast, tailed frogs avoid south-facing drainages because these receive most of the precipitation from incoming storms: extreme precipitation and topography are conducive to dynamic channels. In the leeward mountains of the north, where climate is limiting, tailed frogs thrive best in south-facing basins where stream productivity is high enough to support growth and development. Thus, the river continuum concept has great implications for the protection and management of stream inhabitants.

MOVEMENTS, SPAWNING, AND DISTRIBUTION OF WHITE STURGEON, *ACIPENSER TRANSMONTANUS*, WITHIN THE PRIEST RAPIDS PROJECT AREA, MID-COLUMBIA RIVER, WASHINGTON. DAVE DUVALL, THOMAS J DRESSER JR, *Public Utility District No. 2 of Grant County, Ephrata, WA.*

The Public Utility District No. 2 of Grant County conducted a multi-year white sturgeon (*Acipenser transmontanus*) evaluation to determine what effects the Priest Rapids Project may have on sturgeon movements, habitat, age and growth, recruitment and reproduction. White sturgeon were captured using setlines and tagged with PIT tags plus 1 of 2 tracking tags. Data from sonic-tagged white sturgeon adults documented seasonal movements from over-wintering areas upstream to tailrace spawning areas. Egg mats were placed in the tailrace of each dam to verify spawning success. Priest Rapids Project reservoirs appear to provide suitable habitat for all life stages of white sturgeon. More suitable habitat is available in Wanapum Reservoir,

which also has the larger population of white sturgeon. There may be some sturgeon habitat limitations in Priest Rapids Reservoir that are suggested by the absence of younger age classes. Growth of sturgeon in the Priest Rapids Project Area was similar to that of other populations, with an average increase of 6.5 cm/y. The Priest Rapids Reservoir population showed a skewed sex distribution with a higher proportion of females, while the sex ratio in Wanapum Reservoir showed an even split. Lack of spawning habitat does not appear to be responsible for recruitment limitations, as successful spawning was documented in both reservoir populations. Egg and embryo viability was also confirmed. Possible explanations for the apparent limitations in recruitment may include limited rearing habitat, emigration losses from the population, and potential effects of river flow/regulation.

#### APPARENT EVIDENCE OF SUCCESSION IN SITES DOMINATED BY CHEATGRASS.

RICHARD EASTERLY, DEBRA SALSTROM, *SEE Botanical Consulting, Tenino, WA.*

ENTIAT RIVER WATERSHED: LAND USE & RIPARIAN SURVEY. JUSTIN ERICKSON, KARL LILLQUIST, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA.*

#### EFFECTS OF FIRE ON SMALL ANIMALS AND THE POTENTIAL FOR ANIMALS TO FACILITATE RESTORATION IN HOT DESERT ENVIRONMENTS.

TODD C ESQUE, *USGS Western Ecological Science Center, Las Vegas, NV*; STEPHEN B VANDER WALL, *Biology Department, University of Nevada, Reno, NV*; PHILIP A MEDICA, *US Fish and Wildlife Service, Las Vegas, NV*; ROBERT H WEBB, *USGS Water Resources Division, Tucson, AZ*; CECIL R SCHWALBE, *Southwest Desert Science Center, Tucson, AZ.*

Less than 2% of Mojave Desert scrublands have burned in the past 20 y. But where fires occur, they can substantially change the species composition of desert communities for decades and longer. Hazardous fuels are caused by exotic grasses like red brome (*Bromus madritensis rubens*) and splitgrass (*Schismus* spp.) in the Mojave Desert, or red brome and/or buffelgrass (*Pennisetum ciliare*) in the Sonoran Desert. Biomass of red brome may exceed 2000 kg/ha in years of high production and buffelgrass support greater amounts in most years. Few options exist for the control of red brome or splitgrass at present, but mechanical or chemical treatments to control buffelgrass fuel loads are promising. Recent surveys have shown that fires reduce some long-lived wildlife populations, while merely changing the species composition in others. We found considerable fire effects on species composition in a rodent community after 40 y. Although frequently considered as seed predators, desert rodents have the potential to facilitate recovery. Caching behavior and seed fate studies illustrate that rodents frequently move seeds of blackbrush (*Coleogyne ramosissima*) and Joshua trees (*Yucca brevifolia*). Establishment of blackbrush appears to be linked to infrequent climate pulses. Recovery of native desert perennials will only be successful where fuel hazards can be reduced. Seed fate data in combination with vegetation transects are used to understand long-term population dynamics that have remained mostly undetected because the time-frame for change is greater than the length of most research projects or careers in science.

#### CHANGES IN ABUNDANCE OF CHEATGRASS FOLLOWING WILDFIRE ON THE ARID LANDS ECOLOGY RESERVE, SOUTH CENTRAL WASHINGTON.

JAMES R EVANS, *The Nature Conservancy, Seattle, WA.*

#### NATIONWIDE HERPETOLOGICAL CONSERVATION SCULPTED OUT LOCAL

ACTION. LUKE A FEDEWA, *Partners in Amphibian and Reptile Conservation, Phoenix, AZ.*



PULLING THE LADDER OUT FROM 'OVER' GROUND FIRES IN RIVERSIDE STATE PARK. ROBERT FIMBEL, TOM ERNSBERGER, *Washington State Parks and Recreation Commission, Wenatchee, WA.*

A PHYLOGENETIC STUDY OF PODOCARPACEAE. NICHOLE LY FINE, LINDA A RAUBESON, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

NEARSHORE HABITAT IMPACTS OF LAKE-LEVEL DRAWDOWNS, BANKS LAKE, WASHINGTON. ANTHONY GABRIEL, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA*; LENNARD JORDAN, *Resource Management, Central Washington University, Ellensburg, WA*; KARL LILLQUIST, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA.*

WASHINGTON STATE SOIL—TOKUL SERIES. HERMAN GENTRY, *Washington Society of Professional Soil Scientists.*

HERPETOFAUNA IN SHRUBSTEPPE AND CONSERVATION RESERVE PROGRAM LANDS: PRELIMINARY DATA. STEPHEN S GERMAINE, W MATTHEW VANDER HAEGEN, MICHAEL A SCHROEDER, *Washington Department of Fish and Wildlife, Wildlife Program, Bridgeport, WA.*

Enrolling agricultural lands in the Conservation Reserve Program (CRP) may increase their conservation value to wildlife. However, vegetative composition and structure of enrolled parcels and composition of the surrounding landscape may influence value of individual sites. In 2003, we began investigating site occupation and relative abundance of reptiles and amphibians among 3 site types set within 2 landscape configurations in central Washington. We surveyed agricultural land parcels enrolled in the CRP program during 1998–2000 (new CRP), 1986–1988 (old CRP), and sagebrush-dominated plots, with plots set in both agricultural- and sagebrush-dominated landscapes. In 4 replicates of each treatment type, we employed time-and-area constrained searches and drift fence–funnel trapping from June through August. Overall capture rates were low. We observed 7 species, with short-horned lizards, western rattlesnakes, and western skinks most abundant. Short-horned lizards were the only species encountered in new CRP plots within either landscape type, and they increased in abundance from new CRP to old CRP to sagebrush plots. Western rattlesnakes were encountered in old CRP plots in sagebrush landscapes and in both sagebrush-dominated site types, but were most abundant in sagebrush plots within sagebrush landscapes. Western skinks, racers, gopher snakes, and Great Basin spadefoot toads were encountered only in sagebrush-dominated plots. Species richness and overall abundance (species pooled) were highest in sagebrush plots and lowest in new CRP plots. Old CRP plots supported more individuals and species than new CRP, suggesting increased ability to support herpetofauna as plots matured, but still supported fewer individuals and species than sagebrush-dominated plots.

SMALL MAMMALS OF EASTERN WASHINGTON SHRUB-STEPPE AND CONSERVATION RESERVE PROGRAM LANDS. ROBERT A GITZEN, STEPHEN D WEST, MICHAEL R KROEGER, LINDSAY L MALONE, *College of Forest Resources, University of Washington, Seattle, WA.*

In eastern Washington State, shrub-steppe species are of high conservation concern due to widespread conversion of native habitats to cropland. However, large areas of private land are enrolled in the federal Conservation Reserve Program (CRP), potentially providing important habitat for some species. As a component of a Washington Department of Fish and Wildlife-initiated study, we are comparing small mammal species composition and abundances between CRP fields dominated by exotic grasses and remnant shrub-

steppe sites dominated by big sagebrush (*Artemisia tridentata*). Six habitat categories were chosen by combining 3 site types (shrub steppe, old CRP, new CRP) with 2 landscape categories (predominately farmland or shrub-steppe context). Eight groups of 6 sites each were selected in the northern Columbia Basin, with one 16-ha site per habitat category in each group. Each site was sampled with 124 Museum Special snap traps for 4 nights on four, 300-m transects during late September–October. Here, we report results of our 1st year of sampling, in fall 2003. We captured 2100 small mammals of 11 species during 23,000 trap nights. The deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), and sagebrush vole (*Lemmiscus curtatus*) showed trends toward higher average abundance in CRP fields than on shrub-steppe patches. In contrast, least chipmunks (*Tamias minimus*) were captured only in shrub-steppe habitats and in 2 CRP sites with well-developed shrub cover. Initial results suggest that CRP fields provide valuable habitat for sagebrush voles, but increased shrub cover may be needed if the sites are to support least chipmunks.

WHAT ABOUT THE “RESEARCH” IN RESEARCH NATURAL AREAS? SARAH GREENE, *Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR.*

THE DECLINE OF THE OLYMPIC MARMOT: EVALUATING THE SPATIAL EXTENT AND CAUSES. SUZANNE C GRIFFIN, L SCOTT MILLS, *Wildlife Biology Program, University of Montana, Missoula, MT*; MARK L TAPER, *Department of Ecology, Montana State University, Bozeman, MT.*

Anecdotal reports of local declines and extinctions of Olympic marmots (*Marmota olympus*) in the 1990's, coupled with the precipitous decline of the closely related Vancouver Island marmot, have led to management concerns about this endemic mammal. In 2003, we reported results that indicate that Olympic marmots have declined sharply in several historically occupied areas. Our objectives for the 2003 field season were to continue monitoring previously surveyed sites and to expand our efforts to determine the extent and causes of the decline. At sites where marmots remain, and at several additional sites, we use capture-mark-resight of tagged animals, supplemented with radio-telemetry, to estimate vital rates and determine timing and causes of mortality. In addition, we are surveying potential habitat throughout Olympic National Park. We will use the results to test spatial patterns of extinctions consistent with different causes of declines. In 2002, marmots were absent from 48% of historically occupied sites and disappeared from 3 more by 2003. Annual survival estimates differed greatly between groups of colonies (0.40 vs. 0.95); all mortalities seemed due to predation. Proportions of females weaning litters and litter size were lower in both years than in the 1960's, as were marmot weights. Of 400 surveyed plots, 20% were currently occupied, 9% appeared to have been previously occupied, and 68% showed no occupancy. Plot area and geographic region were correlated with occupancy. Our results to date are consistent with predation, or predation and habitat deterioration together, as the cause of the declines.

MORTALITY BY MOONLIGHT: PREDATION RISK AND THE SNOWSHOE HARE. PAUL C GRIFFIN, SUZANNE C GRIFFIN, *Wildlife Biology Program, University of Montana, Missoula, MT*; CARL WAROQUIERS, *Institute Nationale Agronomique Paris-Grignon, Paris, France*; L SCOTT MILLS, *Wildlife Biology Program, University of Montana, Missoula, MT.*

Optimal behavior theory suggests that prey animals will reduce activity during intermittent periods when elevated predation risk outweighs the fitness benefits of activity. Specifically, the predation risk allocation hypothesis predicts both that prey activity should decrease dramatically at times of high predation risk if there is high temporal variation in predation risk—and that if there is little temporal variation in predation risk, prey will have relatively uniform activity levels. To test these predictions we examined the seasonably variable response of snowshoe hares to moonlight and predation risk. Unlike studies finding uniform avoidance of moonlight in small mammals, we find that moonlight avoidance is seasonal and corresponds to the seasonal variation in moonlight intensity. When the moon was more than half full and the ground was snow-covered, predation rates were higher and snowshoe hare movement distances were lower than near new moons. When the ground was snow-free, full moons changed predation rate only slightly, and snowshoe hare movement did not change according to moon phase. These results support the predation risk allocation hypothesis.

BIOLOGICAL ASSESSMENT AND STATUS OF INLAND SAND DUNES IN EASTERN WASHINGTON. LISA A HALLOCK, REX CRAWFORD, *Washington Department of Natural Resources, Natural Areas Program, Olympia, WA.*

FALL AND WINTER HABITAT USE BY THE OREGON SPOTTED FROG (*RANA PRETIOSA*) AT TROUT LAKE NATURAL AREA PRESERVE, KLUCKITAT COUNTY, WASHINGTON. LISA A HALLOCK, SCOTT F PEARSON, *Washington Department of Natural Resources, Natural Areas Program, Olympia, WA.*

We radio-tracked 13 adult female Oregon spotted frogs from 18 September 2000 to 26 January 2001 to determine fall and winter habitat use at Trout Lake NAP. We examined use of 4 macrohabitat types and microhabitat plot features. On average, frogs were located 11 times over 97 d. The total mean distance moved was 609 m for the 9 frogs that were located >10 times. The farthest distance moved from an original capture point was 437 m. Five frogs (38%) survived the entire study. In the fall, frogs used emergent wetland habitat, open water habitat, and still water areas of the creek. Frogs used emergent and aquatic bed vegetation and small areas of unvegetated substrates more than other cover types. In mid-December, 1 month after the wetland and pond habitats were capped by ice and snow, frogs moved into flowing areas of the creek. Frogs remained active throughout the study, even as water temperatures dropped below 2°C. At the study's end, the remaining frogs were in flowing areas of the creek and 1 frog was in an ice-free spring in scrub-shrub habitat. Microhabitats used by frogs in the creek had significantly higher dissolved oxygen levels than plots in other habitat types. In years when emergent wetland and open water habitats are capped by ice, the creek may provide critical habitat with oxygen levels high enough to sustain frogs.

RESTORING FLOODPLAIN HABITATS IN THE LOWER YAKIMA SUBBASIN. TRACY HAMES, *Yakama Nation Wildlife Resource Management, Toppenish, WA.*

LIVING SNOWFENCES: PROTECTION THAT KEEPS GROWING. DONALD P HANLEY, *Washington State University, Seattle WA*; GARY KUHN, *USDA Natural Resources Conservation Service, National Agroforestry Center, Spokane WA*; DENNIS ROBINSON, *USDA Natural Resources Conservation Service, Spokane WA.*

USING AERIAL PHOTO INTERPRETATION AS A TOOL TO PREDICT FIRE SEVERITY. CHRISTOPHER HEIDER, JERRY MIDDEL, TERRY DROESSLER, *Duck Creek Associates, Inc., Corvallis, OR.*

AN ASSESSMENT OF WATER TEMPERATURES OF THE ENTIAH RIVER, WASHINGTON, USING THE STREAM NETWORK TEMPERATURE MODEL (SNTMP). ROSS R HENDRICK, *Washington State Department of Ecology, Yakima, WA, & Department of Geological Sciences, Central Washington University, Ellensburg, WA*; JOHN T MONAHAN, *Washington State Department of Ecology, Yakima, WA.*

DETERMINANTS OF SONGBIRD ABUNDANCE AND DISTRIBUTION IN SAGEBRUSH HABITATS OF EASTERN OREGON AND WASHINGTON. AARON L HOLMES, DANIEL C BARTON, *PRBO Conservation Science, Stinson Beach, CA.*

We conducted bird surveys and vegetation sampling in sagebrush habitats throughout eastern Oregon and Washington from 2000 through 2002. A primary goal of the study was to develop predictive habitat use models. Site selection and habitat measurements placed an emphasis on understory condition and compo-

sition in order to assess the impacts of degradation and loss of native perennial grasses and forbs on songbirds. Models based on vegetation and habitat variables explained between 40 and 80% of the observed variation in songbird abundance metrics. Understory characteristics were important in explaining variation for 5 of 8 species examined, including 2 shrub-nesting species (gray flycatcher and sage sparrow). In addition, physical variables such as slope and elevation were important predictors for the majority of the species we examined, suggesting wide utility for GIS-based models that do not rely on site-specific vegetation measurements.

GRADIENTS IN TERRICOLOUS LICHEN COMMUNITIES IN THE BERING LAND BRIDGE NATIONAL PRESERVE, ALASKA. EMILY A HOLT, BRUCE MCCUNE, *Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR*; PETER NEITLICH, *National Park Service, Winthrop, WA*.

STORMFLOW DYNAMICS OF DISSOLVED ORGANIC CARBON AND TOTAL DISSOLVED NITROGEN IN A SMALL URBAN WATERSHED. AARON M HOOK, J ALAN YEAKLEY, *Environmental Sciences and Resources, Portland State University, Portland, OR*.

RESPONSES OF POND-BREEDING AMPHIBIANS TO WILDFIRE IN GLACIER NATIONAL PARK. BLAKE R HOSSACK, P STEPHEN CORN, *USGS Northern Rocky Mountain Science Center, Missoula, MT*.

The 2001 Moose Fire on the west side of Glacier National Park burned an area where we have monitored ponds since 1999 for the presence of breeding populations of amphibians, presenting a rare opportunity to contrast pre- and post-fire amphibian distributions and habitats. The year after the Moose Fire we saw no change in the proportion of ponds occupied by the long-toed salamander (*Ambystoma macrodactylum*), but the number of ponds occupied by the Columbia spotted frog (*Rana luteiventris*) increased, and numerous previously unoccupied ponds were colonized by boreal toads (*Bufo boreas*). The same pattern continued in 2003 except fewer ponds were occupied by boreal toads. The proportion of occupied ponds has not changed in a neighboring unburned area where we have 3 y of pre-fire data. No obvious changes in the chemical or physical characteristics of ponds explain the increases in Columbia spotted frog and boreal toad breeding sites, but the Moose Fire data along with surveys in other burned areas of the park suggest that amphibians, especially the boreal toad, may benefit from wildfire.

EARTHQUAKE HISTORY DEDUCED FROM HYDROLOGIC CHANGE IN PRICE LAKE, EASTERN OLYMPIC PENINSULA, WASHINGTON. JONATHAN F HUGHES, *USGS & Department of Earth and Space Sciences, University of Washington, Seattle, WA*.

USING VEGETATION TO ASSESS WETLAND CONDITION: A MULTIMETRIC APPROACH FOR INTERMITTENT AND EPHEMERAL RIVERINE WETLANDS. W MARC JONES, *Montana Natural Heritage Program, Helena, MT*.

RECENT NORTHERN KITTITAS COUNTY, WASHINGTON, DEBRIS FLOWS: ORIGINS AND CONSEQUENCES. MARTIN R KAATZ, *Department of Geography and Land Studies—Emeritus, Central Washington University, Ellensburg, WA*.

CURRENT AND HISTORICAL LIMNOLOGICAL CONDITIONS OF SOAP LAKE, WASHINGTON. JAHN KALLIS, LEO BODENSTEINER, *Department of Environmental Sciences, Huxley College, Western Washington University, Bellingham, WA*; ANTHONY GABRIEL, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA*.

TAXONOMIC AND GEOGRAPHIC VARIATION IN THE OVIPOSITION OF TAILED FROGS (*ASCAPHUS* SPP.). NANCY E KARRAKER, *College of Environmental Science and Forestry, State University of New York, Syracuse, NY*; DAVID S PILLIOD, *USDA Forest Service, Aldo Leopold Wilderness Research Institute, Missoula, MT*; EVELYN L BULL, *USDA Forest Service, Pacific Northwest Research Station, La Grande, OR*; STEPHEN P CORN, *USGS, Aldo Leopold Wilderness Research Institute, Missoula, MT*; LOWELL V. DILLER, *Simpson Timber Company, Korb, CA*; LINDA A DUPUIS, *Ascaphus Consulting, Squamish, BC*; MARC P HAYES, *Washington Department of Fish and Wildlife, Olympia, WA*; BLAKE R HOSSACK, *USGS, Aldo Leopold Wilderness Research Institute, Missoula, MT*; GARTH R HODGSON, *USDA Forest Service, Pacific Southwest Research Station, Arcata, CA*; ERIN J HYDE, *USGS, Forest and Rangeland Ecosystem Science Center, Corvallis, OR*; KIRK LOHMAN, *USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI*; BRADFORD R NORMAN, *Arcata, CA*; LISA M OLLIVIER, *USDA Forest Service, Pacific Southwest Research Station, Arcata, CA*; CHRISTOPHER A PEARL, *USGS, Forest and Rangeland Ecosystem Science Center, Corvallis, OR*; CHARLES R PETERSON, *Department of Biological Sciences, Idaho State University, Pocatello, ID*.

The difficulty of detecting oviposition sites of tailed frogs (*Ascaphus* spp.) has severely limited our understanding of the taxon's reproductive ecology. Given the recently proposed split of *A. truei* into 2 species and the use of *A. truei* as an indicator of watershed condition, a better understanding of breeding sites is increasingly needed for analyses of potential management effects. The objective of this research was to provide a range-wide summary of existing and new information on *Ascaphus* reproduction and oviposition sites. Data on oviposition sites were compiled from field research (40 sites) around the Pacific Northwest from 1991 to 2003, as well as from observations (12 sites) published from 1970 to 2001. We investigated variation in characteristics of oviposition sites, clutch size, timing of oviposition, and frequency of communal oviposition by species and geography. Clutch sizes of *A. truei* were significantly smaller than those of *A. montanus*, and clutch size increased with latitude. *Ascaphus truei* oviposited later in the summer and over a longer duration than *A. montanus*. For both species combined, water temperature and latitude were not associated with timing of oviposition, but oviposition occurred earlier at higher elevations. A greater number of communal oviposition sites were attributed to *A. montanus* than *A. truei*. Our results show differences in clutch size, timing of oviposition, and frequency of communal oviposition between *A. montanus* and *A. truei*. These differences in the reproductive ecology of *A. montanus* and *A. truei* further support the recommendation based on genetic differences for a taxonomic revision of *Ascaphus*.

RHIZOBACTERIA INHIBITORY TO GRASS WEEDS. ANN C KENNEDY, *USDA Agricultural Research Service, Pullman, WA*; TAMI L STUBBS, *Department of Crop and Soil Sciences, Washington State University, Pullman, WA*; ROBERT E VENABLE, *Washington State University, Pullman, WA, and Northwest Agricultural Products, Pasco, WA*.

WHAT MAKES AN INVADER? INSIGHTS FROM CHEATGRASS (*BROMUS TECTORUM*) IN NATIVE, NATURALIZED, AND INVADDED RANGES. CECILIA LYNN KINTER, *University of Wyoming and USFS Rocky Mountain Research Station, Boise, ID*.



DEMOGRAPHIC SURVEYS OF DECLINING SHRUB-STEPPE BIRDS IN SOUTHERN BRITISH COLUMBIA. PAM G KRANNITZ, RICHARD FELDMAN, *Environment Canada, Canadian Wildlife Service, BC.*

The goal of this project was to determine habitat requirements of declining grassland birds in order to develop land management strategies for their benefit. Recent evidence has shown that male songbirds reduce song rate once they become reproductive. To get a more accurate portrayal of reproductive output of different habitat types, birds AND nests were surveyed at 10 to 40 ha sites. In addition, elevation, aspect, slope, ground cover, understory plant species cover, and shrub cover were also measured. We recorded 93 bird species at point-counts and 78 of these were recorded more than once. We found and monitored 152 nests including 129 from Brewer's sparrow, grasshopper sparrow, lark sparrow, and vesper sparrow. As expected, point count estimations of abundance did not accurately portray nest productivity, and sites with high bird density did not necessarily have high productivity. Conclusions regarding habitat preferences for Brewer's sparrow were similar from earlier work based solely on point counts, with sites dominated by *Achillea millefolium*, *Achnatherum nelsoni*, and *Pseudoroegneria spicata* being of the highest quality. For vesper sparrows though, we found that despite earlier conclusions of their being habitat generalists, the location of nests and successful nests was associated with specific habitat needs, including the absence of *Bromus tectorum* and the presence of *Hesperostipa comata* and shrub cover. The results of this project have altered our perspective on managing for shrub-steppe birds by underscoring the importance of nest surveys and showing how different bird species have different habitat and therefore management needs.

OVIPOSITION ECOLOGY OF THE OREGON SPOTTED FROG (*RANA PRETIOSA*) AT TROUT LAKE NATURAL AREA PRESERVE, KICKITAT COUNTY, WASHINGTON.

JEFFREY C LEWIS, *Washington Department of Fish and Wildlife, Olympia, WA*; LISA A HALLOCK, *Washington Department of Natural Resources Natural Heritage Program, Olympia, WA*; WILLIAM P LEONARD, *Washington Department of Transportation, Olympia, WA*; SUSAN VAN LEUVEN, *Washington Department of Fish and Wildlife, Battleground, WA*; DAVID P ANDERSON, *Washington Department of Fish and Wildlife, Trout Lake, WA.*

The Oregon spotted frog (*Rana pretiosa*) is extirpated from approximately 90% of its range; only 4 populations are currently known in Washington. The loss of oviposition habitat contributed to this decline. We investigated oviposition ecology at Trout Lake NAP to determine breeding habitat selection. At the landscape scale, we conducted annual egg mass searches from 1997 to 2003 in emergent wetlands within the Preserve and documented egg mass presence and abundance. As part of an oviposition ecology study in 2001, we investigated habitat selection among used and available sites in areas where spotted frogs laid eggs. Spotted frogs concentrated egg laying in 5 temporarily flooded areas at the upland edge of emergent wetlands. Frogs exhibited fidelity to these 5 areas; however, annual water-level fluctuations influenced oviposition site selection by frogs within these areas. At the microhabitat scale, egg masses were laid in slightly deeper water within the wetland-upland edge, with little or no vegetation cover to block direct sunlight. Spotted frogs initiated egg laying on 12 to 13 March, when water temperatures were about 7.68°C. We identified 78 oviposition sites and the number of egg masses at these sites ranged from 1 to 98. Mean incubation time was estimated at about 20 d; however, variation among individual egg masses was great. Hatching success was 88.4% for egg masses observed in 2001. Management recommendations for breeding sites include preventing invasion of tall emergents and shrubs, maintaining natural hydrology, and continuing annual egg mass monitoring.

MANAGEMENT OF FIRE RISK THROUGH ECOLOGICAL RESTORATION IN SOUTH-CENTRAL WASHINGTON. STEVEN O LINK, *Washington State University Tri-Cities, Richland, WA*; RANDAL W HILL, *US Fish and Wildlife Service, Columbia National Wildlife Refuge, Othello, WA*; ERIC M HAGEN, *US Fish and Wildlife Service, Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge, Richland, WA*; CARSON KEELER, *US Fish and Wildlife Service, Columbia National Wildlife Refuge, Othello, WA.*

DOUGLAS-FIR (*PSEUDOTSUGA MENZIESII*) GROWTH RESPONSE TO CLIMATE VARIABILITY ALONG THE BIOPHYSICAL GRADIENTS. JEREMY S LITTELL, *College of Forest Resources, University of Washington, Seattle, WA*; DAVID L PETERSON, *USDA Forest Service, Pacific Northwest Research Station, Seattle, WA*.

INSECTS AND SELECT TERRESTRIAL INVERTEBRATES OF THE SHRUB-STEPPE ENVIRONMENT: LESSONS FROM THE HANFORD SITE. CHRISTOPHER N LOONEY, *Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID*; RICHARD S ZACK, *Department of Entomology, Washington State University, Pullman, WA*.

OCCURRENCE OF THE VAN DYKE'S SALAMANDER (*PLETHODON VANDYKEI*) AND OTHER STREAM AND SEEP-ASSOCIATED AMPHIBIAN SPECIES IN THE WASHINGTON CASCADE RANGE. ERIC M LUND, CHARLES M CRISAFULLI, AIMEE P MCINTYRE, *USDA Forest Service, PNW Research Station, Olympia, WA*; MARIANNE TURLEY, *USDA Forest Service, Region 6, Portland, OR*.

The Van Dyke's salamander is a rare species endemic to Washington State that occurs in 3 distinct population centers in the Cascade, Olympic, and Willapa Mountains. In 1994 the species was known from only 28 locations in the Cascade Range. Due to a lack of information about its habitat requirements, it was designated as a Survey and Manage species under the Northwest Forest Plan, requiring surveys prior to any ground-disturbing activity planned within its known range. Since this designation 700 pre-project surveys have resulted in 3 new locations. In addition, 4 riparian survey projects conducted at 156 sites from 1994 to 2003 resulted in Van Dyke's salamander detection at 8 (4.2%) sites. The infrequency of detections in upland forests, in combination with results from a habitat associations study of the Van Dyke's salamander, further supports the rarity of this species and its nearly exclusive association with streamside and seep habitats. Opportunistic searches targeting specific and relatively rare habitats produced 20 additional sites, indicating that these habitats will likely be the most valuable approach to finding additional Van Dyke's salamander sites. Ancillary to our Van Dyke's salamander work, we examined data from 302 total stream survey locations to assess the distribution and occurrence of 3 sympatric species. The Coastal tailed frog (*Ascaphus truei*) was the most frequently encountered species in our study area (detected at 61.9% of all sites), followed by the giant salamanders (*Dicamptodon* spp, 30.1%). The Cascade torrent salamander (*Rhyacotriton cascadae*, 13.6%) was well distributed and abundant in most locations in the southern Washington Cascade Range, but an abrupt break in the distribution of this species occurred near the Cowlitz River.

SOFTENING URBAN EDGES: SMALL PLANTS IN HIGH PLACES. ERIN P MARTIN, *Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR*.

VARIATION IN THE OCCURRENCE OF RARE EPIPHYTIC LICHENS IN THE WESTERN CASCADES OF OREGON. ERIN P MARTIN, BRUCE MCCUNE, *Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR*; LINDA GEISER, *USDA Forest Service, Siuslaw National Forest, Corvallis, OR*.

RELATIVE EFFECTIVENESS OF THREE CLASSES OF VARIABLES FOR MODELING THE HABITAT OF *USNEA LONGISSIMA*. BRUCE MCCUNE, ERIN P MARTIN, *Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR*; LINDA GEISER, *USDA Forest Service, Siuslaw National Forest, Corvallis, OR*.

RESEARCH OPPORTUNITIES AND PROBLEMS FROM A MICROBIOTIC PERSPECTIVE AT THE HANFORD REACH NATIONAL MONUMENT, RICHLAND, WASHINGTON. TERRY T MCINTOSH, *Biospherics Environmental, Inc., Vancouver, BC.*

RESEARCH RESULTS FROM A STUDY OF THE BIOLOGICAL CRUSTS AT THE HANFORD REACH NATIONAL MONUMENT, RICHLAND, WASHINGTON. TERRY T MCINTOSH, *Biospherics Environmental, Inc., Vancouver, BC.*

ASSOCIATIONS OF THE VAN DYKE'S SALAMANDER (*PLETHODON VANDYKEI*) WITH BIOPHYSICAL FEATURES. AIMEE P MCINTYRE, *USDA Forest Service, PNW Research Station, Olympia, WA*; RICHARD A SCHMITZ, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR*; CHARLES M CRISAFULLI, *USDA Forest Service, PNW Research Station, Olympia, WA.*

The Van Dyke's salamander (*Plethodon vandykei*) is a rare species endemic to Washington State. It is commonly encountered in cool, moist microhabitats near streams, splash zones of waterfalls, and headwater seeps. We investigated the association between Van Dyke's salamander occurrence and hydrologic condition, geomorphology, disturbance characteristics, and vegetation structure along streams and headwater seeps located in the Cascade Range. We conducted salamander surveys and measured habitat characteristics at 50 streams and 40 seeps May to October, 2000 to 2002. We compared sites where the Van Dyke's salamander was detected with those where the Van Dyke's salamander was not detected at 3 spatial scales: between sites, within sites, and between microhabitat sites. Using logistic regression, with presence or absence as the response, we developed models that predicted Van Dyke's salamander occurrence. To identify the best approximating resource selection model, we ranked *a priori* models using Bayesian Information Criterion (BIC). Results were consistent for both stream and seep sites, at all 3 spatial scales. Best approximating models indicated that the probability of Van Dyke's salamander occurrence along streams was associated with dominant stream and valley wall substrate, valley wall morphology, areas lacking overhead canopy, and the presence of seeps along the valley wall. The probability of Van Dyke's salamander occurrence in seeps was associated with seep hydrology and size, areas lacking overhead canopy, and dominant substrate. The Van Dyke's salamander appears to be associated with habitats that can aid in the maintenance of thermal and hydrological conditions favorable for a species that is sensitive to heat and desiccation due to physiological constraints.

A NON-LETHAL MEANS TO PREVENT BIRD-AIRCRAFT COLLISIONS. RHONDA MILLIKIN, *Canadian Bird Suppression Tech., Vancouver, BC, and EchoTrack Inc., Ottawa, ON*; BRENT M MATSUDA, *Canadian Bird Suppression Tech., Vancouver, BC, and Stillwater Science, Davis, CA.*

Despite several methods to suppress bird use of airport environs, bird-aircraft collisions continue to increase. Collisions threaten human life and annually cost billions to airlines and airport operations. Traditional methods using pyrotechnics, dogs, raptors, and shooting are only effective when continuously applied and an operator is present. Effects typically diminish with habituation. Shooting may lead to population-level impacts for sensitive species over prolonged periods. In 2000, we conducted field trials at a landfill to test a patented new method of "teaching" birds to avoid specific areas by pairing a conditioned stimulus (CS; aircraft lights and sounds), with an unconditioned stimulus (US; a high-pressure water spray), to generate a conditioned response (CR) in birds (avoidance/aversion). Water treatments were effective (100%) in moving birds from the treatment area compared to the use of a hawk and pyrotechnics (76%). Linear regression indicated that the number of water treatments decreased over time as birds were exposed to the CS-US pairing ( $r^2 = 0.90$ ). Two factor ANOVA ( $P < 0.01$ ) indicated a significant effect of treatment on the number of birds to the CS (lights, sounds), but before initiation of the US (water spray). Repeated exposure to the CS-US pairing resulted in a longer time to return and on dispersal distance to the treatment area. Thus birds were able to recognize the warning lights/sounds before the onset of the water spray and altered behavior to avoidance. This may have substantial conservation implications as automated suppression systems con-

nected to radar systems can establish "no-fly" zones. With exposure to a CS, birds learn to respond to avoid pain. This behavior may be learned by offspring and other species.

COMPARISON OF TEMPERATURE EFFECTS ON OXYGEN RESPIRATION IN TEMPERATURE SENSITIVE AMPHIBIANS: IMPLICATIONS FOR CONSERVATION MANAGEMENT. LINDY MULLEN, PATRICK BRYAN, ARTHUR BUCHAN, R STEVEN WAGNER, *Department of Biology, Central Washington University, Ellensburg, WA*; TIM ENGLUND, *Mathematics Department, Central Washington University, Ellensburg, WA*.

Many amphibians in northwest forests are primarily associated with cold, high gradient, well oxygenated, fast flowing headwaters, and small order streams. Subsequently, forest management practices that alter stream temperatures have been suggested to affect their persistence. Further, torrent salamanders (*Rhyacotriton*) have 1 of the narrowest temperature tolerances of any northwest amphibian which, as a consequence, may increase their sensitivity to stream temperature fluctuations. Therefore, we compared the effect of temperature on respiration rates of torrent salamanders (*R. variegatus*, and *R. cascadae*) to sympatrically occurring *Dicamptodon tenebrosus*. Respiration rates were measured for each individual ( $n = 13, 13$ , and  $9$ , respectively) while totally immersed in water at  $10^{\circ}\text{C}$ ,  $15^{\circ}\text{C}$ , and  $20^{\circ}\text{C}$  by using a Polarographic oxygen sensor connected to an oxygen meter (Strathkelvin Model 701). Results indicate significant differences in respiration ( $\text{O}_2/\text{mg/hr}$ ) occurred at each temperature within each species ( $P < 0.00$ ). In addition, the respiration rate of *R. variegatus* was significantly higher than that of *R. cascadae* at  $20^{\circ}\text{C}$  when accounting for weight. Further, the respiration rate at  $20^{\circ}\text{C}$  of *D. tenebrosus* was significantly higher than that of the torrent salamanders, when accounting for weight. In sum, *R. cascadae* had lower rates of respiration at higher temperatures compared to *R. variegatus* and *D. tenebrosus*, which may constrain their ability to adapt to fluctuating stream temperatures.

SPATIAL AND TEMPORAL VARIABILITY IN TREE GROWTH-CLIMATE RELATIONSHIPS IN THE OLYMPIC MOUNTAINS, WASHINGTON. JILL NAKAWATASE, *College of Forest Resources, University of Washington, Seattle, WA*; DAVID L PETERSON, *USDA Forest Service, Pacific Northwest Research Station, Seattle, WA*.

DISTRIBUTION OF THE SISKIYOU MOUNTAIN SALAMANDER, *PLETHODON STORMI*, IN RELATION TO FEDERAL LAND ALLOCATIONS IN SISKIYOU COUNTY, CALIFORNIA. RICHARD S NAUMAN, DEANNA H OLSON, *USDA Forest Service, PNW Research, Station, Corvallis, OR*.

We sampled 69 randomly selected points for Siskiyou Mountain salamanders on Forest Service lands in Siskiyou Co., California. Points were stratified by elevation (above and below 1219 m) and by federal land allocation (matrix and reserved). Limited access and late snow fall during the field season of 2003 resulted in an incomplete sampling of points above 1219 m. However, all randomly selected points below 1219 m were sampled. Detection rates at matrix points (38%) were significantly higher than at reserved points (16%). Potential causes of the different capture rates may include the spatial arrangement of reserved lands that places them at higher elevations and local precipitation patterns.

EFFECTS OF LARGE-SCALE WILDFIRE ON GRASSLAND BREEDING BIRDS ON THE ARID LANDS ECOLOGY RESERVE, HANFORD REACH NATIONAL MONUMENT. HEIDI NEWSOME, BILL LAFRAMBOISE, *US Fish and Wildlife Service, Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge, Richland, WA*; SUSAN EARNST, *USGS, Biological Resources Division, Forest and Rangeland Ecosystem Science Center, Boise, ID*.

The Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge is 1 of the largest remaining examples of shrub-steppe in the Columbia Basin Ecoregion. In June, 2000, a wildfire burned 66,369

ha (164,000 acres), including much of the 31,161 ha (77,000-acre) Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE), a Research Natural Area and the 1st designated Important Bird Area in Washington State. Post-fire vegetation assessments indicated a loss of >75% of the vegetative cover in both sagebrush and bunch-grass communities. Avian diversity and abundance across the ALE have been documented using standardized point counts. Wildfire impacts on avian abundance were analyzed for selected breeding bird species. For this analysis, 3 y of data (1998 to 2000) pre-fire and 3 y post-fire (2001 to 2003) were compared. Grassland bird species including grasshopper sparrow, vesper sparrow, and western meadowlark showed significant declines in mean abundance from pre-fire numbers ( $P < 0.001$ ,  $P < 0.009$ ,  $P < 0.0001$ , respectively). Horned lark did not show a significant difference in pre-fire and post-fire abundance ( $P = 0.29$ ), which may have been due to the high variability in horned lark numbers. Lark sparrow showed a slight increase post-fire ( $P < 0.14$ ). Sage sparrow demonstrated a dramatic decrease due to the loss of nearly all the shrub cover ( $P = 0.002$ ). These results are not intuitively obvious when thinking about the impacts of the fire on vegetative communities on the ALE. General assumptions regarding grassland ecosystems include the assumption that frequent fire invigorates grassland vegetation communities and associated wildlife. Our results are somewhat surprising in that most grassland breeding bird species responded negatively to changes in habitat due to the fire. Frequent fire intervals may reduce habitat suitability for grassland and shrub nesting bird species, especially where historical fire intervals have been disrupted.

PACIFIC NORTHWEST AMPHIBIAN AND REPTILE CONSORTIUM. DEANNA H OLSON, *USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR.*

RIPARIAN BUFFER WIDTHS AND THINNING: EFFECTS ON HEADWATER MICROCLIMATES AND AQUATIC DEPENDENT VERTEBRATES. DEANNA H OLSON, SAMUEL S CHAN, *USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR.*

We examined the effects on microclimate, amphibians, and fishes of 4 riparian buffer widths (6 m, 17 m, 62 m, 120 m; untreated control) with thinning to 200 trees/ha in adjacent upland headwater forests, in 30 to 70-y-old stands previously managed for wood production in western Oregon. Gradients in 1600 h summer microclimate (air and soil temperature, relative humidity) were evident along transects from streams into the thinned upland forest ( $n = 6$  sites). Mean (1600 h) summer air temperature and relative humidity tended to be about 4°C higher and 15% lower, respectively, in the thinned upland forest vs. the control. Riparian buffers averaging as narrow as 17 m wide mitigated the microclimates associated with thinning. Thinning did not affect riparian buffer soil temperature and stream temperature. Aquatic vertebrate richness was relatively high (15 spp), but species abundances often were low and spatially variable, and habitat conditions varied considerably, which may account for inconsistent treatment effects for upslope amphibians (1 of 2 sites) and in-stream and bank animals ( $n = 11$  sites). The occurrence of the headwater-associated torrent salamander at 10 of 11 sites, and 33 of 68 stream reaches was notable. Regardless of treatment, the steepest change in microclimate was often observed within 5 m from the center of the stream where most amphibians were captured. To hedge uncertainty in long-term effects of riparian management on headwater resources, a mix of buffers might be considered for zero-, 1st-, and 2nd-order streams across subdrainages.

INTERACTION OF GLYPHOSATE AND MALATHION ON MORTALITY AND DEVELOPMENT IN CASCADES FROGS (*RANA CASCADAE*). NICOLE K PAULK, R STEVEN WAGNER, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

The worldwide decline of amphibians, which is part of the global loss of biodiversity, has been attributed to many stressors including habitat loss, acid precipitation, increases in ultraviolet radiation, introduced exotic species, and chemical pollutants. However, dramatic decline of individual species may not be the result of single factors but could be from synergistic interactions among different factors. In order to understand potential interactions of widely used herbicides and pesticides, we investigated interaction effects between an herbicide (glyphosate) and pesticide (malathion) on mortality and development of the Cascades frog (*Rana cascadae*). Larvae were treated in static tests that included 5 levels for malathion (0, 0.01, 0.1, 1.0, 5.0 ppb), 5 glyphosate treatments (0, 0.01, 0.1, 1.0, 2.0 ppm), and full factorial treatments for each chemical. All treatment



levels were replicated 3 times. Results suggest that the mean time to death (TTD) for glyphosate treatments was significantly lower at the highest concentration (2.0 ppm;  $3.24 \pm 0.13$  d) than other concentrations, which ranged from no mortality for the duration of the experiment to 13.8 d. Similarly, the highest level of the malathion treatment alone was significantly different with a mean time to death of  $11.3 \pm 0.12$  d when compared to other concentrations (TTD averaged 13.7 d). In addition, the main effect on TTD in interaction treatments was mainly attributable to glyphosate. However, significant differences were observed in among mass of surviving larvae in higher concentrations in interaction treatments. In sum, glyphosate and malathion significantly affect *R. cascadae* larvae mortality and development at levels below EPA-recommended maximum levels for surface water.

OVERVIEW OF RESEARCH ON WASHINGTON'S NATURAL AREAS. SCOTT F PEARSON, *Washington Natural Areas Program, Olympia, WA.*

POSTGLACIAL RECOLONIZATION OF WESTERN HEMLOCK (*TSUGA HETEROPHYLLA* [RAF.] SARG.). RHIANNON PEERY, LINDA A RAUBESON, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

VARIABILITY AND CLIMATE CORRELATION OF GLACIER ANNUAL BALANCES NORTH CASCADES, WASHINGTON, 1984–2003. MAURI S PELTO, *Nichols College, Dudley, MA*; JOSEPH WOOD, *Huxley College of Environmental Studies, Western Washington University, Bellingham, WA.*

IDAHO PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION. CHARLES R PETERSON, *Department of Biological Sciences, Idaho State University, Pocatello, ID.*

EVALUATING EFFECTS OF SEEDING AND FERTILIZING TREATMENTS FOLLOWING WILDFIRE. DAVID W PETERSON, BONITA J SHANAFELT, *USDA Forest Service, Pacific Northwest Research Station, Wenatchee, WA.*

INVESTIGATING MICROSTRUCTURAL VARIATION IN THE *TRNH-PSBA* REGION OF THE CHLOROPLAST GENOME OF CONIFERS. MELISSA M PHILLIPS, LINDA A RAUBESON, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

EFFECTS OF WILDLAND FIRES ON STREAM AMPHIBIAN POPULATIONS IN THE GREATER NORTHWEST. DAVID S PILLIOD, P STEPHEN CORN, *Aldo Leopold Wilderness Research Institute, Rocky Mt. Research Station, Missoula, MT*; R BRUCE BURY, ERIN J HYDE, *USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR.*

Few studies have examined the influence of forest fires on stream amphibian populations. This information is needed by fire managers and ID teams evaluating hazardous fuel reduction projects on federal lands. To understand stream amphibian responses to wildland fire, we sampled 31 burned and 29 unburned streams across 8 watersheds in Idaho, Montana, and Oregon. Streams were sampled at low-flow from May to September, 2001 to 2003. Analyses were conducted on 3 species in Oregon (tailed frog, torrent salamander, and giant salamander) and the tailed frog in Idaho and Montana. For torrent and giant salamanders, the effects of fire on instream habitat conditions appeared to be negligible and both species showed minimal responses to fire. In contrast, tailed frog reproduction or survival of hatchlings was lower in the year of the fire as reflected by low numbers of 1-y-old tadpoles captured 1 y post-fire in streams flowing through burned wa-

tersheds compared to streams in unburned watersheds. In streams where the riparian forest experienced mixed severity burns, tadpoles were patchily distributed probably in response to variable instream conditions. With each additional post-fire year, tailed frog reproduction resumed in many streams in burned watersheds to levels observed in unburned watersheds, but this pattern was highly variable. We suspect that increased light and nutrients may result in increased stream productivity, which will likely have longer term positive effects on tailed frog populations. However, sediment inputs and altered flow patterns may continue to reduce stream habitat quality in some streams. Predicting the direction and magnitude of these biologic and hydrologic processes remains a challenge and requires long-term studies.

HABITAT MANAGEMENT GUIDELINES FOR AMPHIBIANS AND REPTILES. DAVID S PILLIOD, *Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station, Missoula, MT.*

BIOLOGICAL CONTROL PROGRESS AGAINST DALMATIAN TOADFLAX IN EASTERN WASHINGTON. GARY L PIPER, *Department of Entomology, Washington State University, Pullman, WA.*

FINE-SCALE HABITAT SELECTION BY BIRDS IN GROUP RETENTION FORESTS OF COASTAL BRITISH COLUMBIA. MICHAEL I PRESTON, ALTON S HARESTAD, *Simon Fraser University, Burnaby, BC.*

Large-scale spatial factors (for example, distance to road, forest stand size) and vegetation characteristics (for example, tree density, understory composition) are typically used to describe habitat selection by birds. However, if the scale of assessment is not congruent with the scale of resource distribution, these methods can conceal aspects of habitat use and affect interpretation of results. To assess fine-scale habitat selection by birds in group retention settings, we used a 50 × 50-m grid and established point count stations at the corners of each square. Depending on cutblock configuration and group distribution, we used 32 to 40 point counts per site to sample 4.5 to 6.75 contiguous hectares. Locations of all birds were determined using a range-finder and compass during a 10-min sampling period. All species of birds exhibited habitat selectivity, but considerable variability for patch selection or other cutblock structures was evident. The Hammond's flycatcher used patches of all sizes, but did not occupy all patches that were available. The winter wren used larger patches and tended to avoid smaller patches and cut-over areas. The white-crowned sparrow did not use patches, but used the cut-over region extensively. Strong relationships in bird distributions were evident at fine spatial scales, but these would likely not be detected by assessments at larger spatial scales. Variability within species suggests the possibility of spatial, temporal, or structural influences. Further analyses of these fine-scale relationships should reveal important information relevant to habitat use by birds in group retention cutblocks.

BATS AS ECOLOGICAL INDICATORS: A PILOT STUDY ON THE SACRAMENTO RIVER, CALIFORNIA. WE RAINEY, *Department of Integrative Biology, University of California–Berkeley, Berkeley, CA*; E PIERSON, *Berkeley, CA*; C CORBEN, *Columbia, MO*; SB KHANDWALA, CM CHAMPE, BK ORR, *Stillwater Sciences, Berkeley, CA.*

Bats account for much of the native mammal diversity on the floor of the Sacramento Valley. In order to help the Nature Conservancy (TNC) assess success of their restoration efforts on the Sacramento River, bat assemblages were acoustically monitored within 2 habitat types: nut orchards (often the beginning point of TNC's land acquisitions) and mature riparian forest (the desired endpoint of restoration). We used long-term passive acoustic monitoring and visual and capture surveys to investigate bat abundance, species composition, and distribution within 2 orchard sites and 2 mature riparian forest sites. In addition, short-term passive acoustic monitoring was conducted in an existing TNC restoration site. Our results suggest that the bat assemblage along the Sacramento River is more abundant and more diverse than the limited available publications and museum records would suggest. Overall levels of bat activity were positively correlated

with age and structural complexity of terrestrial habitats, with the least amount of activity in orchards and the most in mature forests. At the restoration site, there was consistently more bat activity in the older plot (planted 11 y previous) than in the younger plot (planted 1 y previous). Bats may be useful ecological indicators for monitoring change in river-riparian systems because they likely respond to habitat alterations occurring over broader spatial scales than less mobile animals. The results of our pilot study indicate that existing technology for passive acoustic detection can be used reliably for long-term bat monitoring, with visual surveys to confirm identifications.

PREDICTING ABUNDANCE OF MARBLED MURRELET NESTING PLATFORMS FROM TREE DIAMETER. MARTIN G RAPHAEL, *USDA Forest Service, Pacific Northwest Research Station, Olympia WA.*

The marbled murrelet (*Brachyramphus marmoratus*) is a seabird in the alcid family that forages in coastal marine waters and nests on limbs of large coniferous trees. It is federally listed as Threatened and is a focal species whose conservation was an important feature of the Northwest Forest Plan. Under that plan, much effort has been focused on monitoring murrelet habitat conditions and populations. One of the key features of nesting habitat is the abundance of suitable nesting platforms, defined as limbs 10 cm diameter or limbs with moss or mistletoe. Platform data are not routinely gathered as part of ongoing forest inventories, so a proxy to platform abundance is needed. I explored using tree diameter and species to predict platform abundance in forests of Washington. Observers counted platforms and measured diameters of 13,822 trees in 68 plots. Using logistic regression, I found a very strong correlation between tree diameter and the occurrence of platforms; this relationship differed among tree species. Among all species, individual trees with >100 cm DBH had a 50% or greater likelihood of having platforms. At the stand level, total number of platforms increased with quadratic mean diameter (QMD) of stands up to about 75 cm QMD; platform density was variable among stands, probably reflecting the mix of species present and occurrence of moss and mistletoe. These results indicate that commonly measured stand attributes may be used to predict potential suitability of murrelet nesting habitat.

THE DALLES MOUNTAIN BUTTERCUP, A RARE PLANT WITH SURPRISING LEVELS OF GENETIC VARIATION. LINDA A RAUBESON, SALLIE J HERMAN, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

PHYLOGEOGRAPHY OF NORTHERN POPULATIONS OF THE PACIFIC TREEFROG, *PSEUDACRIS REGILLA*. JENNIFER RIPPLINGER, R STEVEN WAGNER, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

Phylogeography of northern populations of the Pacific treefrog, *Pseudacris regilla*, was investigated using mitochondrial cytochrome b sequence data (725 bp). Thirty-six haplotypes were detected among 59 samples collected from 20 populations. Two divergent coastal and continental clades were supported by several phylogenetic analyses including maximum parsimony, maximum likelihood, and Bayesian methods. Sequence differences among these clades ranged from 5.0 to 6.5%, suggesting they diverged during the Pliocene (about 3 MYA), coinciding with the formation of the High Cascades and subsequent rain shadow in the Columbia Basin. Further, haplotype divergence within each clade was lower (0 to 1.8%), possibly as a consequence of population reduction during the Pleistocene. The overall pattern of divergence was not detected by previous morphological and protein analysis and is concordant with many other northwest taxa. These results do not support previous intraspecific classification schemes, indicating the need for further examination of the taxonomic status of the coastal and continental clades.

THE INFLUENCE OF BIOLOGICAL SOIL CRUSTS ON VASCULAR PLANT GERMINATION. ROGER ROSENTERTER, *Bureau of Land Management, Boise, ID.*

THE EFFECT OF STREAM-CROSSING CULVERTS ON THE MOVEMENT OF COASTAL GIANT SALAMANDERS (*DICAMPTODON TENEBROSUS*). JINA P SAGAR, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR*; DEANNA H OLSON, *USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR*; RICHARD A SCHMITZ, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR*; JOHN GUETTERMAN, *Bureau of Land Management, Coos Bay, OR.*

Barriers to the movement of aquatic organisms can increase the genetic and spatial isolation of populations. Focus on culvert passage issues has increased as federal agencies attempt to inventory and replace road-crossing stream culverts that are barriers to the movement of anadromous fishes. The effect of stream crossing culverts on the movement of other aquatic organisms, however, is not known. In a mark-recapture study on fourteen 3rd- and 4th-order streams (one 75 m reach per stream) in the Oregon Coast Range, we examined summer and overwinter movements of larval Pacific giant salamanders (*Dicamptodon tenebrosus*) in streams with and without culverts. A total of 2215 *D. tenebrosus* were uniquely marked. Among streams, salamander abundances ranged from 0.3 to 3.2 larvae/m. Recapture rates declined overwinter from an overall recapture rate of 35% in August 2002 to 11% in July 2003. Movement distances were small. Mean movement distances were 3 m upstream and 7 m downstream, for summer and overwinter movements, respectively. There was no upstream movement through pipe culverts, summer or winter, and fewer long distance movements on culvert streams than reference streams. *Dicamptodon tenebrosus* habitat use of arch culverts was greater than pipe culverts and similar to natural stream reaches. Integrated analysis of range of movement, directionality, and movement frequency through culvert type will contribute to regional dialogue on culvert design for effective passage.

ASSESSING PERFORMANCE OF GLOBAL POSITIONING SYSTEM RADIO-COLLARS TO STUDY HABITAT USE BY BLACK BEARS IN COASTAL TEMPERATE FORESTS, OLYMPIC NATIONAL PARK, WASHINGTON. KIMBERLY A SAGER, *University of Idaho, Department of Fish and Wildlife Resources, Moscow, ID*; KURT J JENKINS, *USGS, Forest and Rangeland Ecosystem Science Center, Port Angeles, WA*; PATRICIA J HAPPE, *Olympic National Park, Port Angeles, WA*; JOHN J BEECHAM, *Beringia South, Boise, ID*; R GERALD WRIGHT, *Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID*; ROGER A HOFFMAN, *Olympic National Park, Port Angeles, WA.*

We are utilizing Global Positioning System (GPS) radio-collar technology to describe seasonal distribution and habitat selection of black bears (*Ursus americanus*) in temperate coniferous forests of Olympic National Park, Washington. The goal of this study is to describe landscape-scale patterns of black bear distribution in Olympic NP prior to removal of 2 hydroelectric dams from the Elwha River, evaluate GPS fix-acquisition bias in a temperate forest environment, and lay the groundwork for development of population monitoring strategies. Because the performance of GPS radiotelemetry is so poorly understood in the steep, rugged terrain and heavily forested areas of the Pacific Northwest, 1 of our main objectives was to assess fix-acquisition rates by placing GPS radio collars at representative sites in Olympic NP. We have tested GPS collar performance at 64 sites representing a range of forest and topographic obstruction classes. GPS collars, programmed to attempt to obtain hourly locations, were placed at each site for at least 24 h. We used logistic regression analysis to determine the probability of successfully obtaining a fix as related to canopy cover, topographic obstruction, tree size, tree species, and stand structural classes derived from geographic information system data. Probabilities of successful fix acquisition ranged from 0.30 to 0.99 as functions of canopy cover, topographic obstruction, size class, and stand structural class. We conclude that GPS data collected from radio-collared black bears in Olympic NP are biased towards habitats with open forest over-stories and little topographic obstruction. We discuss implications for analyses of animal movements and habitat selection.

CARBON AND NITROGEN POOLS IN DOUGLAS-FIR/PONDEROSA PINE DRY-SITE FORESTS OF EASTERN WASHINGTON. GEORGE SCHERER, JEFF HATTEN, DARLENE ZABOWSKI, *College of Forest Resources, University of Washington, Seattle, WA.*

THE CHANGING FACE OF NATURAL AREAS: A LOOK INTO TRENDS AND FACTORS AFFECTING THE NATURAL AREA PRACTITIONER. REID SCHULLER, *Natural Areas Association, Bend, OR.*

USING TAXA-BASED CONSERVATION PLANS TO EVALUATE ECOLOGICAL EFFECTS OF FIRE MANAGEMENT: INSIGHTS FROM BIRD MONITORING IN OAK WOODLANDS. NATHANIEL E SEAVY, *Klamath Bird Observatory, Ashland, OR; Department of Zoology, University of Florida, Gainesville, FL*; JOHN D ALEXANDER, *Klamath Bird Observatory, Ashland, OR*; PAUL E HOSTEN, *Bureau of Land Management, Ashland Field Office, Medford District, Ashland, OR.*

To evaluate impacts of fuels treatments on oak woodland birds, we used bird monitoring to test predictions generated with a Partners In Flight regional conservation plan. Over a 2-y period, we compared vegetation structure and bird abundance in untreated oak woodlands to woodlands where shrub cover had been removed to reduce landscape fire hazard. We found little evidence that this treatment had an effect on species predicted to respond either positively or negatively to shrub-cover reduction. We suggest that this is a result of the spatial scale of treatments and the retention of shrub patches in treated areas. The most striking difference in bird abundance was a consistently greater number of western wood-pewees (*Contopus sordidulus*) in treated areas. This difference is consistent with the prediction from the conservation plan that this species should increase when management activities increase the amount of edge habitat. Greater numbers of olive-sided flycatchers (*Contopus cooperi*) and purple finches (*Carpodacus purpureus*) at treated stations were the only consistent trends during both years. These species are also associated with edges, providing additional evidence that this treatment changed the bird community by increasing edge habitat. This demonstrates the ability of bird monitoring to identify ecologically important changes that occur as a result of fuels management activities. Monitoring birds is a critical tool for understanding the effectiveness of various treatments in mimicking the effect of fire disturbance as it relates to the maintenance of diversity and processes associated with fire-adapted ecosystems.

POST-BREEDING MOVEMENTS AND HABITAT USE OF THE NORTHERN RED-LEGGED FROG, *RANA AURORA AURORA*, AT DEMPSEY CREEK, THURSTON COUNTY, WASHINGTON. J TUESDAY SHEAN, *Washington State Department of Transportation, Olympia, WA.*

Researchers have voiced concerns that the northern red-legged frog (*Rana aurora aurora*) has undergone regional declines linked to several factors, among which habitat alteration is prominent. Almost no data exist to inform land managers about how northern red-legged frogs move and what habitats are used during movements. This information gap led to this study, the 1st significant one to address northern red-legged frog post-breeding movements and habitat use. In 2001, I used radiotelemetry to track the post-breeding movements of frogs and determine their habitat use and selection patterns across a mosaic of palustrine wetlands near Olympia, Washington. In March through early April, the month following breeding, frogs remained in emergent wetlands where breeding occurred. During this interval, they made frequent, short (<3 m/d), undirected moves that kept them in a relatively small area. In mid-April, frogs abruptly switched to a series of synchronized, directed, infrequent, long (>3 m/d) moves up to 80 m/d that took them from emergent wetland breeding habitat to forested wetlands. By the end of spring, frogs were tracked as far as 312 m away from their original capture positions in the emergent wetland, as a result of these long moves. Long post-breeding movements and habitats selected by northern red-legged frogs may make them particularly vulnerable to landscape changes in a variety of habitats.



OREGON SPOTTED FROG (*RANA PRETIOSA*) HABITAT USE AND EFFECTS OF GRAZING. AMIE M SHOVLAIN, *College of Forestry, Oregon State University, Corvallis, OR*; DEANNA H OLSON, *USDA Forest Service, PNW Research Station, Corvallis, OR*; GREGG RIEGEL, *USDA Forest Service, Deschutes National Forest, Bend, OR*; WILLIAM J RIPPLE, *College of Forestry, Oregon State University, Corvallis, OR*.

We are examining the effects of livestock grazing on amphibian behavior by assessing Oregon spotted frog microhabitat preference in grazed and ungrazed treatments at Jack Creek, Fremont-Winema National Forest, Oregon. Secondary objectives of this study are to identify frog overwintering sites and migration routes, to provide a more complete understanding of seasonal habitat use. Thirteen cattle exclosures were deployed along Jack Creek in the summer of 2003. Seasonal movements were monitored using radio telemetry ( $n = 36$  frogs) on adult frogs from August through December 2003. Frogs were tracked from 5 to 92 d (average 49.5 d) and located 2 to 39 times (average 23.2 times). During the summer and early fall seasons, 22 of 30 frogs remained within 40 m of their original capture sites. In mid October, individuals were located in sheltered areas along the creek such as willow root complexes and abandoned beaver runs. By December 5th, only 2 of the 14 remaining radioed frogs moved  $>50$  m from their summer foraging sites (farthest movement = 120 m). There were no observations of frogs moving over dry land. Jack Creek's network of springs supply the area's only water source for most of the year. For this reason, grazing pressure is particularly high and linear movements along the stream corridor and high site fidelity make these frogs particularly susceptible to disturbance in the riparian zone. During the 2004 summer foraging season, we will use radio-telemetry to continue to evaluate the effect of grazing on frog microhabitat preference.

SWEEPING SCOTCH BROOM FROM THE HOPE ISLAND NAP BALDS. EDWIN SMITH, *Washington State Parks and Recreation Commission, Northwest Region, Burlington, WA*; ROBERT FIMBEL, *Washington State Parks and Recreation Commission, Olympia, WA*.

BASELINE HYDROLOGY AND WATER QUALITY STUDIES AT KINGS LAKE BOG, WASHINGTON. JAMES M STROH, *Geology and Scientific Inquiry, The Evergreen State College, Olympia, WA*.

THE EXPECTED POTENTIAL NATIVE VEGETATION OF THE KITTITAS VALLEY. ALLEN E SULLIVAN, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA*.

A TREATISE ON THE IMPORTANCE OF FIRE IN MAINTAINING HEALTHY HABITAT FOR WILDLIFE. DALE SWEDBERG, *Sinlahekin Wildlife Area, Washington Department of Fish and Wildlife*.

CULTURAL RESOURCE CONSERVATION AND PRIVATE LAND DEVELOPMENT AT THE POINT, 45-KT-1368. MORRIS L UEBELACKER, *Department of Geography and Land Studies, Central Washington University, Ellensburg, WA*.

ABUNDANCE AND PRODUCTIVITY OF SHRUBSTEPPE BIRDS IN WASHINGTON: LOCAL AND LANDSCAPE EFFECTS AND RESPONSE TO LARGE-SCALE HABITAT RESTORATION. W MATTHEW VANDER HAEGEN, *Washington Department of Fish and Wildlife, Olympia, WA*; MICHAEL A SCHROEDER, *Washington Department of Fish and Wildlife, Bridgeport, WA*.

Over half of the native shrub-steppe in Washington has been converted to agricultural lands, resulting in a fragmented landscape with few extensive tracts of shrub-steppe. The pattern of shrub-steppe conversion

has resulted in a disproportionate loss of deep soil communities and an increase in the proportion of shallow soil shrub-steppe communities on the landscape. Recent studies by the Washington Department of Fish and Wildlife have used transect and point-count surveys along with nest monitoring and behavioral observations of color-marked birds to examine the effects of landscape change on shrub-steppe passerines. Abundance of 8 species showed strong relationships with soil type and 3 with range condition. Sage sparrows occurred more frequently in landscapes dominated by shrub-steppe and were more likely to occur in large (>1000 ha) blocks of shrub-steppe. Parasitism rates, predation rates, and fledging success were documented for 1240 nests. Nest parasitism by brown-headed cowbirds was infrequent (<8%), and parasitism had little effect on productivity. Brewer's sparrows, sage thrashers, and lark sparrows had lower nesting success in fragmented landscapes, largely as a result of nest predation. Sage sparrows and Brewer's sparrows showed evidence of lower seasonal productivity in fragmented landscapes, although the mechanisms likely differed between species. Current research focuses on use of Conservation Reserve Program fields by birds and the potential role of CRP in the long-term conservation of shrub-steppe birds in Washington. Results from our 1st field season indicate heavy use of CRP fields by several species, but an overall lower diversity than in native shrub-steppe.

**RHIZOBACTERIA IMPACT PLANT SURVIVAL AND COMPETITION.** ROBERT E VENABLE, *Washington State University, Pullman, WA, and Northwest Agricultural Products, Pasco, WA*; ANN C KENNEDY, *USDA Agricultural Research Service, Pullman, WA*; TAMI L STUBBS, *Department of Crop and Soil Sciences, Washington State University, Pullman, WA*.

**THE UNIQUE SPORES OF THE LICHEN *TEXOSPORIUM SANCTI-JACOBI*.** JENNIFER VON REIS, *Biology Department, Columbia Basin College, Tri-Cities, WA*.

**EFFECTS OF SPATIAL PATTERNING OF HABITAT TYPES ON SNOWSHOE HARE ABUNDANCE IN THE OKANOGAN NATIONAL FOREST.** CARLY WALKER, SCOTT MILLS, KAREN HODGES, *Department of Wildlife Biology, University of Montana, Missoula, MT*; GARY KOEHLER, *Washington Department of Fish and Wildlife, Cle Elum, WA*.

Snowshoe hare (*Lepus americanus*) habitat quality has traditionally been defined by stand-level attributes, such as structure and dominant species or patch size. However, stands with comparable stand-level characteristics often exhibit dramatic variation in snowshoe hare densities. Because inter-patch movements influence snowshoe hare distribution, the spatial patterning of habitat types to one another may be important in determining hare densities. I hypothesize that landscape-level variables that quantify the spatial relationship of a stand to others on the landscape are better indicators of snowshoe hare habitat use than are finer-scale stand-level variables. Using an information-theoretic approach, I am evaluating the relative importance of stand- and landscape-level variables on hare density, indexed by pellet counts. I am also tracking radio-collared hares at night and examining movement patterns in relation to spatial arrangement of habitat types. Stands surveyed in 2003 show a mosaic of hare densities across the landscape. Initial analyses confirm that stand-level variables leave much unexplained variance, justifying analyses with landscape-level variables. Preliminary radio telemetry results show hares in high quality stands moving frequently across stand boundaries to access neighboring stands of moderate to good quality. However, in high-quality stands bordered by low-quality neighbors, hares move less frequently across boundaries.

**COMMUNITY, COMPROMISE, COMMITMENT AND COLLABORATION: A CASE STUDY OF WATERSHED PLANNING IN THE ENTIAT RIVER VALLEY.** SARAH M WALKER, *Chelan County Conservation District, Wenatchee, WA*.

WATER RESOURCES ASSESSMENT AND PLANNING IN THE ENTIAT WATER RESOURCE INVENTORY AREA (WRIA 46). SARAH M WALKER, *Chelan County Conservation District, Wenatchee, WA.*

THE ECOLOGY OF THE NIGHT SNAKE (*HYP SIGLENA TORQUATA*) WITHIN THE YAKIMA RIVER CANYON. ROBERT E WEAVER, *Department of Biological Sciences, Central Washington University, Ellensburg, WA.*

Prior to 2002, only 41 specimens of *Hypsiglena torquata* had been recorded from Washington State. Since 2002, an additional 52 specimens have been collected within the Yakima River Canyon of Kittitas and Yakima Counties of south-central Washington. In this talk I present data on life history traits of *H. torquata* from this locality. Data were collected from both alive on road (AOR) and dead on road (DOR) specimens encountered along a 19.5 km stretch of State Route 821 (Yakima River Canyon), from May 2002 to October 2003. All DOR specimens were examined in the lab for stomach contents and for reproductive status. Additionally, AOR specimens were palpated in the field for stomach contents and their reproductive conditions were assessed. Specimens ranged in size from 8.5 to 58.5 cm in length and 0.95 to 32.5 g in mass. Night snakes in the canyon appear to feed only on western skinks (*Eumeces skiltonianus*). Male night snakes with enlarged testes were found from May through August. Females with enlarged follicles and ova were found from June through August. Snakes were found to be active primarily from 2000 to 0230, at a wide range of temperatures (10.0 to 36.5°C). However, 2 specimens were observed diurnally active. These data show that, although secretive, *H. torquata* is very abundant at this locality, and may prove so at other localities within the state. My data also lend support to the hypothesis that *H. torquata* may reach a larger body size here in the Pacific Northwest than in other parts of its range.

THE DISTRIBUTION, ABUNDANCE, AND LIFE HISTORY OF THE RING-NECK SNAKE (*DIADOPHIS PUNCTATUS*) AND SHARP-TAILED SNAKE (*CONTIA TENUIS*) WITHIN THE YAKIMA RIVER BASIN OF KITTITAS AND YAKIMA COUNTIES.

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As part of ongoing studies on the ecology of snakes within the Yakima River Basin, we present data on the distribution, abundance, and life history of 2 secretive snake species, the ring-neck snake (*Diadophis punctatus*) and the sharp-tailed snake (*Contia tenuis*). Since 1994, 24 specimens of *D. punctatus* and 19 specimens of *C. tenuis* have been recorded from Kittitas and Yakima County. The majority of these specimens have been collected at new localities along the Yakima River or its tributaries. Snakes were collected while crossing roads, under cover boards, or when specimens were brought to us. The length, mass, sex, and if possible the reproductive status of each of specimen were recorded. In addition, locality, time of capture, humidity, and air and substrate temperature were noted. Few specimens of either species contained prey items. Reproductive data are available from only 2 female *D. punctatus*, and 5 (2 male, 3 female) *C. tenuis*. Our study shows that *D. punctatus* is found primarily along creeks in shrub-steppe, oak-woodland, and ponderosa pine-Douglas-fir zones within the basin. *Contia tenuis* is found in similar areas, and in areas of human disturbance (agricultural, residential, and commercial areas). Our results indicate *C. tenuis* to be more abundant and more widely distributed within the Yakima River Basin than previous records show, while *D. punctatus* appears to have a more limited distribution than *C. tenuis* in both counties.

COUNTERING MISINFORMATION CONCERNING BIG SAGEBRUSH. BRUCE L WELCH, *USDA Forest Service, Rocky Mountain Research Station, Provo, UT*; CRAIG CRIDDLE, *National Wildlife Federation, Downey, ID.*

LEAVE ISLANDS AS REFUGIA FOR LOW-MOBILITY SPECIES IN MANAGED FOREST MOSAICS. STEPHANIE J WESSELL, RICHARD A SCHMITZ, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR*; DEANNA H OLSON, *USDA Forest Service, PNW Research Station, Corvallis, OR.*

REPRODUCTIVE BEHAVIOR OF THE FOOTHILL YELLOW-LEGGED FROG (*RANA BOYLI*). CLARA A WHEELER, *Department of Wildlife Management, Humboldt State University and USDA Forest Service, Redwood Sciences Laboratory, Arcata, CA*; HARTWELL H WELSH JR, *USDA Forest Service, Redwood Sciences Laboratory, Arcata, CA*.

The foothill yellow-legged frog (*Rana boylei*) is a medium-sized frog that occurs in rivers and streams of Oregon and California. To examine the mating strategy of these frogs, we observed activity during 2 breeding seasons at Hurdygurdy Creek, California. Frogs were pit-tagged, SUL measured, weighed, and individually marked with unique color-beaded belts in order to visually identify them during behavioral observations. We monitored the breeding activity, based on number of new egg masses and male frogs attending the breeding site and systematically documented locations and interactions among frogs. We collected microhabitat data for egg masses and random sites to examine oviposition-site selection. Results indicated that water flow and water depth at oviposition sites were significantly lower than for random sites ( $P = 0.0001$  and  $P < 0.005$ , respectively), suggesting site selection. This population did not exhibit size-assortative mating ( $r = 0.13$ ). Male frogs maintained and defended territories at the breeding site. However, based on our observations, they are not defending high-quality oviposition sites. Derived from preliminary results, we propose that this may be a lek mating system. In addition, we observed and recorded a previously undocumented oviposition behavior in which a female frog prepared a cobble for egg mass attachment.

PHYLOGENY, TAXONOMY, AND POPULATION STRUCTURE OF *HEMPHILLIA BURRINGTONI* AND *H. GLANDULOSA* BASED ON GENETIC AND MORPHOLOGICAL ANALYSES. THOMAS WILKE, *Animal Ecology & Systematics, Justus Liebig University, Giessen, Germany*; JOAN ZIEGLTRUM, *USDA Forest Service, Olympia, WA*.

VEGETATION CLASSIFICATION USING MAP COINCIDENCE AND PATTERN RECOGNITION. GEORGE WOOTEN, DAVE DEMYAN, *Pacific Northwest Division, Planetary Science Institute, Winthrop, WA*; HANS SMITH, *Pacific Biodiversity Institute, Winthrop, WA*.

THE REPRODUCTIVE BIOLOGY OF WENATCHEE MOUNTAINS CHECKER-MALLOW: AN EXPLORATORY LOOK AT A RARE ENDEMIC. TARA GOLDSMITH ZIMMERMAN, *Washington State University Extension, King County, Renton, WA*; SARAH REICHARD, *College of Forest Resources, University of Washington, Seattle, WA*.